Paula G. Coble

Associate Professor
College of Marine Science
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Project Oceanography
Executive Producer

Ph.D. in Chemical Oceanography
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Paula received a bachelor's degree in Biology/Geology from Mt. Holyoke College in South Hadley, Massachusetts. She then earned a master's degree in Marine Studies from the University of Delaware. After receiving her degree she worked at the Bigelow Laboratory for Ocean Sciences where she participated in research cruises and learned how to write papers and proposals. In 1983, she enrolled in the M.I.T. and Woods Hole Oceanographic Institution Joint Program in Oceanography, and completed her degree in Chemical Oceanography in 1990. Following this time, Dr. Coble, spent three years as a Postdoctoral Research Fellow at the University of Washington College of Ocean and Fisheries Science.

Paula's research involves the study of sources, cycling, and chemical composition of dissolved organic carbon (DOC) in the ocean. DOC plays a major role in the global carbon budget. Dr. Coble uses satellites and spectroscopy to study the ocean.

At Project Oceanography, Paula's major responsibilities include planning the program schedule and making sure the broadcasts and teacher packets are the best that they can be. She works closely with the Project Oceanography staff, the production team, and the science hosts to make sure the whole program runs smoothly. Another aspect of her job is helping the science hosts design their programs to be both understandable and interesting to middle school students.

Carlos de la Rosa

Education Coordinator
Dept. of Environmental Management
Pinellas County, Florida

Ph.D. in Ecology
University of Pittsburgh

Carlos was born in Caracas, Venezuela and received his Ph.D. from the University of Pittsburgh. He has been biodiversity advisor for various projects with the Organization of American States, the US agency for International Development, and several nonprofit organizations in Central and South America. He was the director of the Riverwoods Field Laboratory (Florida Atlantic University), the US AID's Environmental Management Office, in Costa Rica, and is the current president of the International Foundation for Environmental Restoration, Education and Management. He has held teaching and research positions at West Virginia University, the Philadelphia Academy of Natural Sciences, and is Adjunct Professor at Florida Atlantic University and the University of Central Florida. He is the author of a book on Central American mammal conservation and numerous articles in journals and magazines.

Mark E. Luther

Associate Professor
College of Marine Science
University of South Florida

Ph.D. in Physical Oceanography
University of North Carolina
at Chapel Hill

Mark received an A.B. in Mathematics and Physics in 1976 from the University of North Carolina at Chapel Hill followed by a M.S. in Physical Oceanography in 1980. He continued his education at Chapel Hill and earned a Ph.D. in Physical Oceanography in 1982. During his educational period, Mark worked as a research assistant in curriculum for the Marine Sciences and was a postdoctoral fellow at the Center for Ocean-Atmospheric Prediction Studies at Florida State University. He has been at USF since 1990 as is currently an Associate Professor in the College of Marine Science.

Dr. Luther's research involves the development of numerical models of ocean currents and processes and their application to various problems ranging from water quality in Tampa Bay to variability in large-scale ocean circulation and its relation to climate change. He is an internationally known expert on the wind and thermally driven circulation in the tropical oceans and is active in many national and international scientific societies.

Mark is presently the US National Delegate to the International Association for Physical Sciences of the Ocean. He was also closely involved in the planning and implementation of a major international expedition to the Indian Ocean. His research group designed and implemented a shipboard computer system to receive and display information on ocean temperatures, weather patterns, and modeled ocean circulation patterns.

Dr. Luther manages the Tampa Bay Physical Oceanographic Real-Time System (PORTS) at USF. This system measures tides, currents, and winds around the bay and disseminates this information to the public every six minutes. With his graduate students, he has combined the PORTS technology with a model of currents and water level in Tampa Bay to predict the movement of oil spills or other hazardous material spills.

Unit IV Brooker Creek Preserve

Information contained in this packet is taken from a website developed by Conrod Associates for the Pinellas County Board of County Commissioners. For additional information concerning the water cycle and watersheds, please refer to the Project Oceanography Fall 2000 Neighborhood Water Quality packet.

Brooker Creek Preserve was established by the Pinellas County Board of County Commissioners for the preservation of the region's great diversity of natural communities and the Brooker Creek watershed. The county's Environmental Management Department is working to develop land management, research, and educational programs. They are on the cutting edge of science by using "real-time" data to teach environmental concepts to Pinellas County students. The Environmental Distance Learning program uses an Internet-based learning solution to deliver constant, real-time environmental data coordinated with science curriculum standards.

The Brooker Creek Watershed Learning Project

Lesson Objectives: Students will be able to do the following:

- Describe a watershed
- Name three ways a watershed can be influenced by urbanization
- Explain one way a watershed effects water quality

Key concepts: watershed, controlled burn, ecosystem, environmental distance learning (EDL)

Brooker Creek Overview

The Brooker Creek Preserve, located in northeast Pinellas County, Florida is an example of one of the many important **watersheds** found throughout the United States. This area is of particular interest because it includes more than 8000 acres of wilderness located in one of the most populated areas in Florida. This situation offers a unique opportunity to study the effects of urbanization on **habitat** diversity and water quality along with land management practices and restoration efforts.

Brooker Creek Preserve is an ecologically diverse area encompassing a wide variety of habitats including pine flatwoods, freshwater marshes, palmetto prairies, sandhills, and cypress

swamps. Environmentalists have found over 500 plant species living in this area, including some rare and threatened ones, such as the Catesby's Lily, Dahoon Holly, and Royal Fern. In addition, the preserve is home to a wide variety of animals including the Southern Bald Eagle, the American Alligator, and the Gopher Frog. As a watershed, the Brooker Creek basin prevents flooding by storing excess water. It also is important in recharging the groundwater supplies used by many communities for drinking water, and it protects the watersheds of surrounding areas by decreasing the flow of polluted waters over these basins.

Historically, Brooker Creek has been affected by increased pressures from urbanization, as have many other watershed areas. Beginning in the 1800's as lands were settled, agricultural operations expanded into the watershed. Cattle farming resulted in channelization of the creek and some habitat destruction from grazing practices. Later utility corridors were cut through the watershed to satisfy the demand from customers. This caused some disruption in sheetflow characteristics and also disturbed floodplain vegetation. Vehicular traffic was also a concern as off road vehicles destroyed habitat, including vegetation. Today restoration efforts are underway. Land management techniques focusing on limiting vehicular traffic, removing exotics, and implementing **controlled burns** are being used to try to restore the watershed.

Importance of the Preserve in Maintaining Water Quality

Water is a limited natural resource that is affected by virtually every aspect of the environment as it is cycled through the system. Thus, water quality can be a good indicator of the health of an **ecosystem**. Rainwater is absorbed by the ground or filtered into larger bodies of water and ultimately flows into the ocean. It is heated by the sun, evaporates back into the atmosphere, and condenses into clouds, being released as rainfall again. During this process it can pick up **pollutants** from areas as it flows over the ground and streets, around buildings and homes, and through yards and drainage systems.

If scientists measured the chemical characteristics of this water, they would find that it is not pure H_2O but a solution made of several chemicals with distinguishing characteristics. By studying the relationships between these characteristics, scientists can make predictions about how this water will affect plants and animals. For instance,

nutrient levels may be high if there is fertilizer run off from nearby areas. This in turn can cause a change in **pH** level and stimulate algal growth. Algal growth rates can affect the amount of oxygen available to aquatic organisms.

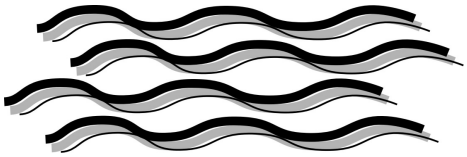
The Brooker Creek watershed provides an opportunity to study the effects of water quality on the health of the surrounding environment. Scientists have installed fiber-optic sensors called **"spectrometers"** to measure the water quality in the Brooker Creek drainage system. They have also set up **"Web Cams"** to monitor activity in this area. This information is then recorded and used by scientists to study watershed impact and effective restoration practices. It is also accessed in Pinellas county classrooms, so students can study the effects of urbanization on this local watershed and become involved in real world science investigations..

How and Why the EDL Program was Developed

The Pinellas County Environmental Distance Learning project was conceived as a result of a collective vision for enhanced Internet-based distance learning. This vision is shared by Pinellas County, Florida, the University of South Florida, area Junior Colleges, Middle School educators, and Conrod Associates Communications. It is supported by the Pinellas County Environmental Foundation (PCEF) and the Pinellas County Board of County Commissioners.

The EDL project approaches the study of environmental issues from a societal viewpoint. By combining the resources available in Pinellas County, Florida with real-time data collection, students using the latest technology become classroom scientists. They gather and analyze data as it becomes available in "real time". This Internet based program, aligned with the district science curriculum, also provides educators with lesson plans formatted to teach skill sets necessary to fulfill district requirements.

Activity: Watershed Comparisons



Watersheds provide natural areas for water runoff. In these areas, water is cleaned as it flows through the system before it drains into a nearby water body. The natural contour of the land and the vegetation help direct the water on its path. As it percolates through the soil, it is cleaned and stored in underground aquifers. Humans can impact the natural balance of this system, as population growth requires construction of more buildings. Watersheds around the United States can be compared and studied to help resolve some of the problems associated with this increased urbanization.

Objectives: Students will be able to do the following:
1. Use the Internet to acquire information.
2. Identify the factors that contribute to watershed health.
3. Use maps to make physical comparisons of watersheds.
4. Use data to evaluate watershed health.

Materials:
- Internet access to the following websites:
  EDL website sponsored by the Pinellas County Board of County Commissioners (Please watch the Project Oceanography programs for the website address.)
  The U.S. Geological Survey's Water Education website at http://www.epa.gov/surf
- Questions from the activity page
- Paper and pencil

Procedure:
1. Discuss the types of information available about watersheds on the Internet.
2. Explain that in this activity students will be accessing information from two websites.
3. Have students access the EDL website. (Be sure to take time to study the map of Brooker Creek Preserve.)
4. Have students answer the following questions using information from the site:
   Where is Brooker Creek Preserve located?
   How big is Brooker Creek Preserve?
   Name two types of ecosystems found in the preserve.
   What does "pyroclimatic" mean?
5. Have students access the U.S. Geological Survey's website.
6. Have students use the locator map to find a watershed in their area, and use the information to determine the health of that watershed.
7. Have students use the locator map to find the Brooker Creek Preserve watershed (It will be located in Pinellas County, Florida near the cities of

Clearwater, St. Petersburg, and Tampa.), and use the information to determine the health of the watershed.
8. Compare the health of the two watersheds. Include information such as the criteria used to determine watershed health and the factors that influence these criteria.

Possible Extensions:
1. Have students draw and label maps of the watersheds they are comparing.
2. Have students use these maps to make visual comparisons of the watersheds.
3. Have students research several watersheds to see if they can draw correlations between watershed health and population density.

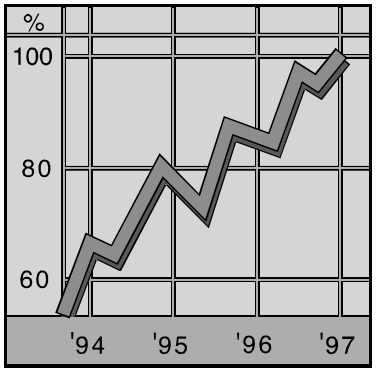
Student Information: The Brooker Creek Watershed

Brooker Creek Preserve is a natural **watershed** area covering over 8000 acres. In its natural state it provides **habitat** for an abundance of plants and animals. It is also important for providing rainwater storage to prevent flooding in this large basin. Water is filtered through the porous soil to be cleaned and stored in underwater **aquifers** to replenish groundwater supplies used by many communities as a source of drinking water.

Humans have affected this watershed because it lies within one of the most urbanized areas in Florida. As humans began to build structures, lay down pipes, construct power lines, and destroy the habitat with recreational vehicles, the effectiveness of the watershed has changed. Now the water is not as clean as it has been in the past and aquatic animals are no longer able to live in some of these areas.

Today this watershed is being restored through management techniques including **controlled burns**, habitat restoration, and **exotic** species removal as well as by limiting construction and vehicular traffic. Scientists are recording the changes in water quality as this restoration takes place using the newest electronic **sensors**, which measure water quality indicators. These measurements called **data** are recorded and stored in a **database**, providing a sort of history of water quality. The database can be used to study changes in the watershed and to learn how best to manage it.

Students can then use this information to understand how informed citizens make decisions that effect their environment.



The Brooker Creek Watershed Interactive Database

Information in this packet is taken from a website developed by Conrod Associates for the Pinellas County Board of County Commissioners.

Lesson Objectives: Students will be able to do the following:

- Name three water quality parameters that are being measured at Brooker Creek
- Compare traditional meteorological instruments to those used at Brooker Creek
- Explain how to set up a database

Key concepts: spectrometric instruments, electronic sensors, telemetry, "real-time" data, databases

Parameters and Sensors at Brooker Creek

As we discussed in the first program, Brooker Creek provides an opportunity to study a **watershed** and its impact on water quality without leaving your office or classroom. In order to do this, scientists placed **sensors** in three areas of Brooker Creek: one upstream, one midstream, and one downstream. These sensors collect a variety of data relating to the chemical and physical aspects of the water that flows through Brooker Creek. Scientists also set up **web cams** to take pictures of the area and supply additional information.

The chemical parameters of the water include such characteristics as **pH** and **dissolved oxygen** levels. In the past we have measured these characteristics using chemical test kits. The researchers at Brooker Creek Preserve measure these parameters using light sensitive sensors that are only a few inches long. These spectrometric instruments measure the energy levels associated with various light wavelengths. (For additional information on **spectrometry** and light wavelengths, see the Project Oceanography Spring 1999 packet for Ocean Technology and the Fall 2000 packet for Sounds of the Sea Lesson 1.)

The physical parameters measured include the surface water level, **precipitation**, and related **meteorological** parameters such as wind speed, **barometric pressure**, and temperature. The **surficial water level** is the depth of the water

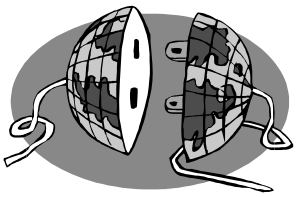
in the creek. Scientists use a sensor based on the **acoustic** properties of the water. It works much like **echolocation** in that the instrument measures the time it takes a sound to travel the distance from the water's surface to the bottom of the creek bed. The device used to measure precipitation is a simple tube attached to an electronic sensor. The sensor is activated in response to the water level in the tube. It then measures the capacity of the tube and flushes the system after the measurement has been recorded. Sensors attached to towers measure the atmospheric parameters. The mechanical parts of these instruments are similar to traditional ones except they are connected to electronic mechanisms that measure and record the information and send it to a computer system.

The use of electronic sensors and modern **telemetry** allows the data to be immediately relayed to a computer system and sent all over the world via the Internet. The sensor readings are constantly changing as chemical and physical properties change. This automated system allows scientists to keep track of the changes as they occur. This is called **"real-time"** data collection.

Real-time data collection is important to researchers, because it allows them to make predictions based on comparisons of measurements over time. For instance, if you took your body temperature every day for a month, you would find small changes from day to day, but your measurements would be within the "normal" range of about 98.6°. If there were a big and sudden change, you would know that something was wrong. Perhaps you have the flu! If scientists took measurements every hour, for a month they could also pinpoint times of abnormal readings that may help them to determine environmental problems.

Introduction to Databases

The information collected from the instruments installed at Brooker Creek watershed provide an ongoing **database** that is designed for easy information retrieval and modification as needed. This system allows for flexibility with regard to use and topic. For instance, characteristics can be compared at different locations at one time or one characteristic can be studied over time at a single site. In addition, **data** is archived so it can be used for comparisons at a later date.

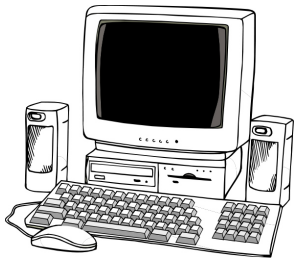


By using "real-time" data, students learn to manage information containing temporal and spatial components. They begin to

understand that this data provides a picture of what is happening in the environment, and that individual components are merely indicators of a more complex system. This can then lead to higher level critical thinking involving such topics as the interrelatedness of biotic and abiotic factors, cause and effect relationships, and the place of ecosystem components in the overall picture.

Students become involved in real world science by using the EDL "real-time'" Internet program. They have the opportunity to understand the importance of sound scientific practice and how it relates to everyday life. Hopefully this will move students to incorporate behavior changes that would lead to stewardship and activism.

Brooker Creek Data Graphing



The Internet allows easy access to the latest information. By using the real-time data available on the EDL website, students have the opportunity to understand the scientific process involved in data collection and usage. Students are able to apply math and science principles to real world situations.

Objectives: Students will be able to do the following:
1. Collect data from the EDL website.
2. Create graphs using the data.
3. Compare data.

Materials:
- Internet access to the EDL website sponsored by the Pinellas County Board of County Commissioners (Please watch the Project Oceanography programs to obtain the website address.)
- Graph paper
- Paper and pencil
- Colored Pencils

Procedure:
1. Explain to students that they will be graphing data from the EDL website.
2. Have students access the website and locate the appropriate data.
3. Have students make a table to record the upstream temperature of Brooker Creek over a given time period.
4. Have students use this information to create a line graph. Discuss the significance of this data.
5. Have students create a table including the pH levels of Brooker Creek at all three sites over a given time period.
6. Have students create a graph using lines to represent data at each of the three sites. Have students compare and discuss the results.
7. Have students create a graph showing the correlation between water temperature and dissolved oxygen level in midstream over a given period of time. Have students discuss the results.
8. Have students answer the following questions:
   Can data be depicted in other ways?
   Are bar graphs appropriate for comparing this data?
   What can you infer from the data collected?

Possible Extensions:
1. Have students decide if a pictograph could be drawn to represent water level.

2. Have students create graphs using spreadsheet files.
3. Have students compare other parameters such as water temperature vs. air temperature. Discuss the validity of the results and the limiting factors.
4. Have students formulate questions concerning the data.

Student Information: Brooker Creek Science

Scientists are using the latest technology to gather information about the chemical and physical characteristics of Brooker Creek. They have placed “web cams” at the site that take pictures of the area, so people can see what is happening in the preserve. They have also placed tiny electronic instruments in the Brooker Creek watershed to record information that reflects water quality. Some of these tiny sensors react to light to determine such water characteristics as pH and dissolved oxygen. Other sensors react to sound to record such things as water level. This data is then instantly fed from the sensors into a computer system without the use of wires and can be broadcast all over the globe via the Internet as it is being collected.

Personnel at Brooker Creek are gathering data in “real-time” or as it is registered on the equipment. By taking measurements at short intervals over long periods of time, scientists can determine the health of the ecosystem. Using this information, they may also learn how specific activities affect water quality. In addition, researchers could determine patterns for making predictions about the system they are studying. For instance, riding your all terrain vehicle may destroy plants that would slow water runoff and prevent flooding. Since this water is now passing more quickly through the system, it may not be cleaned of pollutants before it reaches the bay. This could cause fish kills.

Today with the latest technology, you can become a real world scientist. By logging on to the EDL website, you can see what is happening at Brooker Creek right now. The information you find can help you make comparisons between the water characteristics and predict some trends for the water quality in the watershed.

Brooker Creek Vocabulary

Acoustic-referring to sound

Aquifer-an underground water system made of porous rock and sand

Barometric pressure-force per unit area produced by a column of atmosphere

Channelization-to form streambeds that water will follow

Controlled Burn-land management technique using fire to restore a natural area

Data-factual information used for analysis

Database-a collection of information arranged for ease of search and retrieval

Dissolved oxygen-the amount of free oxygen found in water

Echolocation-a method of locating objects by determining the time for an echo to return and the direction from which it returns, as by radar or sonar

Ecosystem-a community of living organisms

Exotic-not native; introduced from abroad; foreign

Fiber-optic cable-transparent fibers through which light passes to transmit data, voices, or images

Habitat-area or environment in which an organism normally lives or occurs

Meteorological-pertaining to the atmosphere, especially the weather

Nutrient-a source of food

pH-a measure that indicates the relative acidity or alkalinity of a substance. pH ranges from 1 (most acidic) to 14(most basic), where a pH of 7 is neutral

Pollutant-harmful waste material

Precipitation-all the forms of water deposited on the earth from the atmosphere. They include rain, snow, frost, hail, dew, etc.

Real-time-term used to describe data collection as it happens

Sensor-a device that receives and responds to a signal

Spectrometer-an instrument used to measure energy at specific wavelengths

Spectrometry-optical measurement of the energy of specific wavelengths to study the interaction of light with matter

Surficial water level-water depth, measured from the surface to the creek bed

Telemetry- transmission of data by wire, radio, or other means from remote sources, as from space vehicles, to receiving stations for recording and analysis

Watershed-an area of land over which water flows to reach a common body of water such as a lake or pond

Web Cam-camera that sends pictures to the Internet

Brooker Creek References

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